CONNECTOR WITH PROTRUSION ADAPTED FOR INTERCONNECTION WITH SECOND MEMBER

BACKGROUND OF THE INVENTION

Enteral tubes for providing food and medication to a patient are well known. For example, U.S. Patent No. 4,666,433, entitled Gastrostomy Feeding Device, invented by Parks and issued May 19, 1987; U.S. Patent No. 4,701,163, entitled Gastrostomy Feeding Device, invented by Parks and issued October 20, 1987; U.S. Patent No. 4,798,592, entitled Gastrostomy Feeding Device, invented by Parks and issued January 17, 1989; and U.S. Patent No. 4,685,901, entitled Gastro-Jejunal Feeding Device, invented by Parks and issued August 11, 1987 disclose earlier feeding tubes.

Referring to the illustrative drawing of Figure 1A, there is shown a perspective view of an earlier enteral feeding device 20. The device 20 includes an elongated tubular member 51 formed from a stretchable elastomeric material such as silicone. Figure 1B is an illustrative cross-sectional view of the tubular member 51 of the earlier device. The tubular member 51 defines a jejunal tube 22, a gastronomy tube 34 and a fluid line 46.

The jejunal feeding tube 22 (Figures 1A and 1B) includes an outlet end portion 24 (Figure 1A) which can extend through a patient's stomach into the jejunum. The jejunal tube outlet end portion includes perforations 26 (Figure 1A) which permit liquid food or medication to pass therethrough. The tube 22 (Figures 1A and 1B) is integrally connected to a jejunal tube inlet end portion 28 (Figure 1A) which defines a jejunal inlet port 30 (Figure 1A) having a removable plug cover 32 (Figure 1A).

The gastrostomy tube 34 (Figure 1A) is shorter than the jejunal tube 22 (Figures 1A and 1B) and includes a plurality of drainage inlets or food outlet ports such as inlet/outlet 36 (Figure 1A). A gastrostomy tube end portion 37 (Figure 1A) defines a gastrostomy inlet port 38 (Figure 1A) having a plug cover 40 (Figure 1A).

An inflatable balloon 42 is provided near the end of the gastrostomy tube 34 (Figures 1A and 1B) and is inflatable through a valve 44. The valve 44 is used to supply fluid to the balloon 42 through the fluid line 46 (Figures 1A and 1B).

Frictional contact between the elongated tubular member 51 (Figures 1A and 1B) and a locking ring 56 (Figure 1A) is sufficiently great to prevent the tubular member 51 (Figures 1A and 1B) from moving further into the stomach. The locking ring 56 (Figure 1A) remains in contact with a patient's abdominal wall during use. However, the

frictional contact is sufficiently low to permit adjustment of placement of the tubular member 51 (Figures 1 and 1B) relative to a patient's abdomen.

Referring to the illustrative drawings of Figure 2, there is shown a perspective view of an earlier device 20 in use. The inflated balloon 42 forms a gasket that seals the entrance to the stomach, and together with the locking ring 56, secures the device 20 in place.

While prior feeding tubes generally have been acceptable, there have been shortcomings with their use. In particular, for example, in order to provide food or medication to the jejunal inlet port 30 (Figure 1A) of device 20 (Figure 1A), a connector, such as a first connector 58 illustrated in Figure 3 or a second connector 60 illustrated in Figure 4, is inserted through the jejunal inlet port 30 (Figure 1A). The inserted connector 58 (Figure 3) or 60 (Figure 4) is mechanically coupled to the jejunal inlet port 30 (Figure 1A) and serves as a conduit between the jejunal tube 22 (Figures 1A and 1B) and an external feeding tube 62 or 64, shown in Figures 3 and 4 respectively. The external tube 62 or 64 is connected to a source of food such as a feeding bag (not shown).

In practice, connectors 58 or 60 such as those shown in Figures 3 and 4, for example, may be inserted into and removed from the jejunal inlet port 30 (Figure 1A) or the gastrostomy inlet port 38 (Figure 1A) numerous times during the course of use of the device 20 (Figures 1A and 2) which can be installed in a patient's stomach for extended periods of time. As mentioned above, the tubular member 51 (Figures 1A and 1B) which defines the jejunal tube inlet end 28 (Figure 1A), and the gastrostomy tube end portion 37 (Figure 1A) can be formed from a stretchable elastomeric material such as silicone. In order to produce an adequate mechanical coupling between the connector 58 (Figure 3) or 60 (Figure 4) and either the jejunal inlet port 30 (Figure 1A) or the gastrostomy inlet port 38 (Figure 1A), the connector is forced into place so as to produce a frictional engagement. Repeated insertions and removals of such connectors 58 (Figure 3) or 60 (Figure 4) can cause the jejunal inlet port 30 (Figure 1A) or the gastrostomy inlet port 38 (Figure 1A) to become somewhat stretched and deformed over time.

Unfortunately, as the jejunal and gastrostomy inlet ports 30, 38 (Figure 1A) become more and more stretched in this manner, the tendency of a medical attendant responsible for coupling such a connector to the inlet ports 30, 38 often is to more forcibly push the connector into the jejunal or gastrostomy ports 30 or 38 resulting in still further stretching. Moreover, more force often must be exerted to dislodge a connector after such a forced insertion. Additionally, as the interior of the inlet ports 30, 38

becomes soiled with food oils, for example, an attendant may attempt to push a connector into the port even more forcibly in order to compensate for the slipperiness of such oils, causing further deformation of the port opening.

The problem of achieving a tight fit between a jejunal or gastrostomy inlet port 30 or 38 (Figure 1A) and such connectors 58 (Figure 3) or 60 (Figure 4), for example, has been exacerbated by the fact that in the past, such connectors often have been available in a variety of shapes and sizes. This variety will be apparent from the illustrative drawings of Figures 3 and 4 in which the first and second connectors 58, 60 have quite different shapes. Consequently, in the past it often has been desirable to construct jejunal or gastrostomy inlet ports, that can accommodate any of a variety of such differently shaped connectors. Unfortunately, such earlier inlet ports often could not readily accommodate such a variety of differently shaped connectors without the need to forcibly insert or forcibly remove the connectors.

Even with the advent of feeding tubes incorporating ferrules, the variety of connectors which are frequently used therewith can still lead to the forcing of the connector and the feeding tube together to make a secure connection. Depending on the tube and connector being used this forcing still may not be sufficient to create a connection which retains the connector in the tube so as to avoid an unintentional and/or undesired disconnection. Further, if sufficient force is applied during the connection of the prior connectors and tubes it may be such that the components are difficult to separate when desired. Such difficulties in separation may result in displacement of the feeding tube and/or discomfort to the patient during the attempted separation or even after the connector is ultimately separated from the tube.

Thus, there has been a need for a device to permit any of a variety of different shapes and sizes of connectors to be inserted into or removed from an inlet port of a feeding tube without the need to use excessive force and substantially without deforming the feeding tube inlet port while still providing for the retention of the connector. The present invention meets these needs.

SUMMARY OF THE INVENTION

In response to the difficulties and problems discussed above, a connector configured to be releasably interlocked with a ferrule has been developed. More specifically, one aspect of the present invention is directed to a connector adapted for use with a feeding set formed from flexible material. The connector generally includes a body with a conduit therethrough and protrusion. The body has a first end, a second

end, an inner surface and an outer surface. The protrusion extends from the outer surface of the body and is configured to be received in a second member so as to allow the connector and the second member to be releasably interconnected.

Another aspect of the present invention relates to an adapter for use with a feeding tube. The adapter includes a body with a bore therethrough and a protrusion. The body has a first end, a second end, and an outer surface. The outer surface of the body has a plurality of regions having different diameters and may have at least one bevel, wherein the bevels connect two regions having different diameters. The protrusion extends from the outer surface of the body and is configured to be received in a second member so as to allow the adapter and the second member to be releasably interconnected. The protrusion is located along the outer surface between the first end and the second end of the body.

Another aspect of the present invention is directed to a connector adapted for use with a feeding tube formed from flexible material including a body with a conduit therethrough, the body having a first end, a second end, an inner surface and an outer surface. The outer surface has at least two regions with different diameters and at least one bevel, wherein the bevel connects two regions along the surface of the body having different diameters. The protrusion of the connector extends from the outer surface of the body and is desirably configured to be received in a second member so as to allow the connector and the second member to be releasably interconnected.

The invention will be more fully understood and further features and advantages will become apparent when reference is made to the following detailed description of exemplary embodiments of the invention and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The purpose and advantages of the present invention will be apparent to those skilled in the art from the following detailed description in conjunction with the appended drawings in which:

Figure 1A is a perspective view of an earlier feeding tube;

Figure 1B is a cross-sectional view along line 1B-1B of Figure 1A;

Figure 2 is a perspective partially cutaway view of an earlier feeding tube installed in a patient;

Figures 3 and 4 are side elevation views of earlier connectors for insertion into end portions of a feeding tube;

Figure 5 is a perspective view of a connector having a protrusion in accordance with the present invention;

Figure 5A is a perspective view of an alternative connector having a protrusion in accordance with the present invention;

Figure 6 is a perspective view of a ferrule;

Figures 6A and 6B are top and bottom elevation views of the ferrule of Figure 6;

Figure 7 is a side elevational view of a connector in accordance with the invention interconnected with a second member;

Figure 7A is a side elevational view of a connector in accordance with the invention interconnected with a second member;

Figures 8 and 8A are perspective views of an alternative connector in accordance with the present invention.

Figure 9 is a cross-sectional side elevation view of the ferrule of Figure 6;

Figure 9A is a cross-sectional side elevation view of the alternative embodiment of the ferrule of Figure 6; and

Figure 10 is a cross-sectional side elevation view of another alternative embodiment of the ferrule of Figure 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description will be made in the context of a connector which is adapted for medical use. It is readily apparent, however, that the article of the present invention would also be suitable for use with other types of systems, circuits or conduits and the like and is not intended to be limited to medical devices or use in a medical field. In addition, the invention will be described in the context of its various configurations. It should be appreciated that alternative arrangements of the invention can comprise any combination of such configurations. As such, the use of a desired embodiment, a connector having a protrusion adapted for use with a feeding tube, for ease in understanding and describing the invention shall not, in any manner, limit the scope of the invention.

Reference will now be made to the drawings in which the various elements of the present invention will be given numeral designations and in which the invention will be discussed so as to enable one skilled in the art to make and use the invention. It should be appreciated that each example is provided by way of explaining the invention, and not as a limitation of the invention. For example, features illustrated or described with respect to one embodiment may be used with another embodiment to yield still a further

embodiment. These and other modifications and variations are within the scope and spirit of the invention.

Turning now to the drawings, and Figure 5 in particular, there is illustrated a perspective view of a connector 200 in accordance with a present embodiment of the invention. The connector 200 shown includes a body 204 with a conduit or bore 206 therethrough. The body 204 has a first end 208, a second end 210, an inner surface 212 and an outer surface 214 as well as a protrusion 202 extending from the outer surface 214 of the body 204. The protrusion 202 is configured to be received in a second member (illustrated as ferrule 70 in Figure 6) so as to allow the connector 200 and the second member to be releasably interlocked or interconnected.

Although, as discussed in more detail herein, the protrusion may be in a variety of sizes and shapes, the protrusion 202 shown in Figures 5, 5A and 7 is merely exemplary and is illustrated as such for purposes of discussion and understanding. It will be appreciated that the size and shape of the protrusion 202 may be dictated in part by the second member the connector 200 is intended to be used with.

For purposes of discussion and understanding of the present invention an exemplary second member (e.g., ferrule 70) is shown in Figures 6 and 7. The second member shown in Figures 6 and 7 is merely exemplary and the dimensions of the various aspects thereof may vary in size and shape. One will appreciate that the connector 200 (Figures 5, 5A and 7) of the present invention may be configured to be received in any suitable second member. A more detailed description of an exemplary second member is described in commonly assigned copending U.S. Patent Application Serial Number __/_____ entitled "FERRULE AND ENTERAL TUBE INCORPORATING A FERRULE" (Attorney Docket No. 18,866), which is incorporated by reference in its entirety.

Referring again to Figure 5, the connector 200 is shown having an outer surface 214 which has regions with different diameters. Although the connector need not have regions having different diameters, it is generally desired that a connector, such as that shown as 200 in Figure 5, have at least two such regions 222, 224 having different diameters so as to more readily allow the connector 200 to be compatible with multiple second members. Those embodiments of the present invention which have multiple regions with different diameters along the outer surface 214 of the connector 200 also desirably include at least one luer or bevel 216 that connects two regions (e.g. 222 and 224 or 224 and 226) of the outer surface 214 of the body 204 having different diameters.

In one embodiment of the present invention the outer surface 214 of the body 204 of the connector 200 may be tapered at least in part. Depending on the embodiment this taper may be, for example, a luer or bevel (e.g. 216 in Figure 5) or it may be another region of the outer surface 214 of the body 204 such as 222a, 224a, 226a (see Figure 5A). That is, for example, in one embodiment of the present invention the outer surface 214 of the body 204 of the connector 200 may be generally parallel to the central axis 218 of the connector 200 as in Figure 5 or the outer surface 214 of the connector 200 may be inclined relative to the central axis 218 so as to form a taper as shown in Figure 5A. It will be appreciated that multiple tapers may be present on one connector. Further, it is contemplated that the interior surface 212 of the connector 200 may be tapered.

Depending on the number, type and size of tapers which are present on the connector 200, the adapter can take a variety of forms and shapes including, for example, a universal connector or a "Christmas tree" connector. As discussed in more detail herein, tapers along the outer surface 214 of the connector 200 may be configured for engagement with a second member to promote or assist in the creation of a seal, lock, gasketing effect or the like between the two components.

Referring again to the protrusion 202 of the connector 200 as seen in Figures 5, 5A and 7, it will be appreciated that while the protrusion may be of any suitable size and shape, the position of the protrusion 202 on the connector 200 may affect the dimensions of the protrusion. Although the protrusion 202 may be located on or extend from the ends 208, 210 of the connector 200, it is generally desirable for the protrusion 202 to be located or positioned along the outer surface 214 of the body 204 of the connector 200 between the first end 208 and the second end 210 of the body 204. More desirably, the protrusion will be located closer to the first end 208 than the second end 210. Furthermore, while the protrusion 202 may protrude from the connector 200 at any suitable angle relative to the central axis 218, it is generally desirable for the protrusion to protrude from the connector at angle of about 80° to about 100°, and more desirably about 90° relative to the central axis 218. Again, as will be apparent from the discussion herein, the size, shape and location of the protrusion may depend on the connector and second member intended to be used therewith.

In the past connectors, such as those shown in Figures 3 and 4, used with feeding bags and enteral feeding devices were permanently fixed to the feeding sets or bags because they were not intended for multiple use nor were they intended for

attachment at the time or point of use to tubes, feed bags, feeding sets, or the like. Advantageously, the connectors of the present invention need not be permanently attached (e.g. sonically bonded, glued, etc.) to the tube or feeding set it is intended to be used therewith. That is, one or more embodiments of the present invention can have a connection mechanism (not shown) at the first end 208 (Figures 5, 5A and 7) of the body 204 (Figures 5, 5A and 7) which may be used to releasably attach the connector 200 (Figures 5, 5A and 7) to a tube (not shown). The advantages and benefits of a releasably attachable connector are numerous, and some of those advantages and benefits are discussed in commonly assigned copending U.S. Patent Application Serial Number __/_____ entitled "CONNECTOR WITH CONNECTION MECHANISM ADAPTED FOR RELEASABLE INTERCONNECTION WITH TUBE" (Attorney Docket No. 19,690B), which is incorporated by reference in its entirety. Any suitable connection mechanism is contemplated by the present invention. Examples of suitable connection mechanisms include, but are not limited to, slip connect, screw connect, slip fit, friction fit, grommets, boss, detent, compression fittings, compression sleeves and the like.

Referring now to Figures 6 and 7, there is shown an exemplary configuration of a second member, and more specifically, in this embodiment, a ferrule 70, which is suitable for receiving a connector of the present invention. As shown, this embodiment includes a slot 77 which extends through the wall 71 of the ferrule. As illustrated the slot has a first portion or leg 77a and a second portion or leg 77b. The slot 77 is adapted to receive a protrusion 202 (Figures 5, 5A and 7) on a connector 200 (Figures 5, 5A and 7) inserted into ferrule 70 (Figures 6 and 7). It is contemplated that the slot 77 may extend through entire width of the wall 71 of the ferrule 70, however, it is also contemplated that the slot may only extend through a portion of the wall 71 of the ferrule 70 (e.g. as to form a recess in the wall). Also, while shown between end surface 73 and rib 74a in Figure 6, slot 77 may be in any suitable position in ferrule 70. That is, for example, at least a portion of the slot may extend through at least a portion of the end surface 73 (Figure 6) of the ferrule; however, depending on the size of the connector and the location of the protrusion 202 (Figures 5, 5A and 7) thereon, the slot 77 (Figures 6 and 7) in the ferrule 70 (Figures 6 and 7) may be located closer to the end 75 (Figures 6 and 6B) of the ferrule opposite end surface 73, and the slot need not extend into or through end surface 73. Depending on the size of the slot 77 (Figures 6 and 7) and the extent to which it extends into or through the wall 71 (Figures 6 and 7) of the ferrule 70 (Figures 6 and 7),

a suitable connector may be selected. Alternatively, a suitable second member may be selected based on the dimensions of a connector that is selected for use.

Further, although not illustrated, more than one slot 77 (Figures 6 and 7) may be present in a ferrule 70 (Figures 6 and 7). Multiple slots 77 in a ferrule 70 would provide the opportunity to use the ferrule 70 with a connector having multiple protrusions (see, for example, Figures 8 and 8A) and/or the ability to be used with connectors having different protrusion configurations either of which may lead to the creation of a better seal between the components and/or better retention of the connector. Furthermore, a portion of the slot 77 (Figures 6 and 7), desirably the second portion 77b (Figures 5A and 12), may be tapered (not shown) at least in part so as to be configured to create a friction fit with the protrusion 202 (Figures 5, 5A and 7) of the connector 200 (Figures 5, 5A and 7) inserted into the ferrule 70.

Figures 6A and 6B respectively show top elevation and bottom elevation views of a ferrule 70. In Figure 6A, there is shown an inlet opening 78 generally surrounded by the top annular rib 72. In Figure 6B, there is shown an outlet opening 80 surrounded by the bottom annular rib 76. In one embodiment, the ferrule 70 may be formed from a hard substantially non-deformable material such as plastic, metal, glass or polyvinylchloride. Desirably, the ferrule 70 is formed from a material that is acid-resistant and gamma-stabilized so that it can withstand a sterilization process involving irradiation.

The illustrative drawing of Figure 9, shows a cross-sectional view of the ferrule 70 of Figure 6. First, second and third interior wall regions exemplarily shown as 82, 84 and 86 define a conduit 88 extending between the inlet opening 78 and the outlet opening 80. The respective first, second and third interior wall regions 82, 84 and 86 each desirably have substantially cylindrical contours and are aligned along a central axis 90 of the conduit 88.

As explained more fully below, the first, second and third interior wall regions 82, 84 and 86 may define three separate surfaces which may be taper lock surfaces. Each of these interior wall regions can be sized and contoured to conform to the shape of a different portion of a connector or to multiple connectors so as to enable the use of ferrule 70 with a variety of connectors. For example, the first interior wall region 82 can be sized and contoured to conform to the shape of a portion of a connector such as that shown as 58 in Figure 3 or 60 in Figure 4 or 200 in Figures 5, 5A and 7. The second interior wall region 84 (Figure 9), for example, can be sized and contoured to conform to

the shape of another portion of the connectors in Figures 3-5A and 7 or another connector altogether. Moreover, the third interior wall region 86 (Figure 9), for example, can be sized and contoured to conform to the shape of yet another connector (not shown) with a narrower body shape or another portion of the connectors discussed above. It will be appreciated that the interior wall regions of Figure 9 are drawn to a different scale than the connectors of Figures 3-5A and 7.

A taper lock may be caused by a frictional engagement force that results when a connector 200 (Figures 5, 5A and 7) becomes lodged within the ferrule 70 (Figures 6 and 7) because of, for example, tapered surfaces 82, 84, 86, 92, 94 (Figure 6) or 216, 222a, 224a, 226a (Figure 5A) which come in contact with another surface which is also desirably tapered.

Thus, for example, when a connector such as that shown as 200 in Figures 5, 5A and 7 is inserted into the inlet opening 78 (Figures 6A and 9) of the ferrule 70 (Figures 6 and 7), it can become lodged against the first interior wall region 82 (Figure 9), desirably forming a taper lock with it. Alternatively, for example, connector 58 (Figure 3) could become lodged against a shoulder of the ferrule such as 92 or 94 (Figure 9). Likewise, when a connector having appropriate dimensions is inserted into the inlet opening 78 of the ferrule 70, it can become lodged against one or more of the other interior wall regions (e.g. 84 or 86), forming a taper lock or the like therewith. In accordance with the present invention, it will be appreciated that the creation of a taper lock or the like between the ferrule 70 and a connector desirably should not prevent the rotation or movement of connector relative to the ferrule 70 so as to enable the interlocking discussed herein. As discussed below, the present invention also contemplates instances in which a taper lock or other seal between the ferrule 70 and one or more wall regions of a connector is not made.

A more detailed description of the desired sizing and contour of one embodiment of the ferrule 70 of Figure 9 follows. The first interior wall region 82 is shown with walls 82, 84 and 86 that are inclined relative to the central axis 90 so as to define a generally conical shape in which a diameter of a first segment of the conduit 88 defined by the first interior wall region 82 decreases with increasing distance from the inlet opening 78. A first interior annular shoulder 92 demarcates the end of the first interior wall region 82 of the ferrule of Figure 9.

As will be appreciated, the interior walls of a ferrule may engage one or more of the regions of the body 204 (Figures 5, 5A and 7) of a connector 200 (Figures 5, 5A and

7) of the present invention so as to assist in the connection and/or retention of the components relative to each other and/or to reduce or minimize fluid leaks between the components.

A second segment of the conduit 88 is shown in Figure 9 as being defined by the second interior wall region 84 which also is substantially conical in shape. Like the first interior wall region 82, the walls of the second interior wall region 84 may be inclined relative to the central axis 90 such that the diameter of a second conduit segment decreases with increasing distance from the inlet opening 78. A second interior annular shoulder 94 demarcates the end of the second interior wall region 84 of the ferule of Figure 9.

A third segment of the conduit 88 is shown in Figure 9 as being defined by the third conical interior wall region 86. The walls of the third interior wall region 86 are shown inclined relative to the central axis 90 such that the diameter of the third conduit segment decreases with increasing distance from the inlet opening 78. In one embodiment, the dimensions of the third interior wall region 86 may be those of a luer so as to be adopted to engage a portion of a connector.

It will be understood that alternative ferrules can, for example, be constructed in accordance with the invention in which the wall regions are generally parallel to central axis, but that a portion of the wall region is inclined relative to the central axis of the ferrule so as to be dimensioned as luer. For example, in Figure 9A, wall regions 182, 184 and 186 of ferrule 170 are shown as being generally parallel to central axis 190, while surfaces 192 and 194 are shown as being inclined relative to the central axis 190 and may be dimensioned as luers.

Additionally, one will appreciate that, although the above described embodiments disclose smooth inner wall regions (e.g. 82, 84, 86 shown in Figure 9), a taper-lock can be formed in which inner wall regions have contours formed in them such as ridges, steps, bumps and the like. Alternatively, the connector may be formed such that the outer surfaces (e.g. 214 in Figure 5) have contours formed in them such as ridges, steps, bumps and the like.

As noted and discussed in more detail herein, a connector 200 (Figures 5, 5A and 7) and ferrule 70 (Figures 6 and 7) may create a lock or seal (e.g. a taper-lock) between one another; however, as discussed in more detail herein, the ferrule 70 also has at least one slot 77 (Figures 6 and 7) therein which is capable of receiving a protrusion 202 (Figures 5, 5A and 7) on a connector 200 such as that shown in Figures 5,

5A and 7. It will be appreciated that while the term slot is used throughout this disclosure for ease of reading and understanding, and while not intending to be limited thereby, the term slot is intended to also include groove, channel, opening, recess, aperture and the like. It will also be appreciated that while reference is made to a protrusion 202 (Figures 5, 5A and 7), any suitable guide, flange, extension, prong, or the like also may be used. However, for ease of reading and understanding of this disclosure, and not intending to be limited thereby, protrusion will be used hereafter.

Although illustrated in Figures 6 and 7 in a generally "L" shape, slot 77 of the ferrule 70 may be of any suitable shape and size. That is, for example, the second portion 77b of an "L-shaped slot" may be inclined or declined relative to the central axis 90 (Figure 9) of the ferrule 70 (Figures 6 and 7) or the slot may be at least partially curved, T-shaped, U-shaped or the like. It is also contemplated that the slot 77 may have in at one least portion thereof a non-smooth surface or other mechanism (not shown) so as to enhance the ability of the ferrule 70 (Figures 6 and 7) to retain its position with a connector 200 (Figures 5, 5A and 7) so as to minimize or reduce inadvertent or undesired separation of the components.

Although desired that the connector of the present invention be used with a ferrule having a slot, it is contemplated that a connector in accordance with the present invention may be used in conjunction with either a ferrule 70 (Figures 6 and 7) with a slot 77 (Figures 6 and 7) as discussed above or with a ferrule lacking a slot capable of receiving the protrusion of the connector. When the connector 200 (Figures 5, 5A and 7) of the present invention is used in conjunction with a ferrule having a slot which is capable of receiving the protrusion 202 (Figures 5, 5A and 7) on the connector 200 and acting in conjunction with the projection 202 to retain or assist in maintaining the positioning of the connector 200 (Figures 5, 5A and 7) relative to the ferrule 70 (Figures 6 and 7), the protrusion 202 (Figures 5, 5A and 7) should be aligned with the slot 77 (Figures 6 and 7) to allow the connector 200 (Figures 5, 5A and 7) to be inserted into the ferrule 70 as illustrated in Figure 7. The ferrule 70 (Figures 6 and 7), and more specifically the slot 77 (Figures 6 and 7) therein, is desirably designed such that a protrusion 202 (Figures 5, 5A and 7) may be closely received first within a first portion or leg 77a (Figures 6 and 7) of the slot 77 (Figures 6 and 7). Then, the connector 200 (Figures 5, 5A and 7) and protrusion 202 (Figures 5, 5A and 7) may be rotated relative to the ferrule 70 (Figures 6 and 7) so as to be received within the intersecting second portion or leg 77b (Figures 6 and 7) of slot 77 (Figures 6 and 7) in a manner to

releasably interlock the connector 200 (Figures 5, 5A and 7) with the ferrule 70 (Figures 6 and 7). Such an interlocking connection can provide a way to retain the position of a connector relative to a ferrule, even in those instances where a taper lock or other connection or seal between the outer surface of the connector and the ferrule (as discussed above) is not present or achieved.

It will be appreciated that in any embodiment, but especially those where a taper lock or the like is not created between the connector and the second member, the connector may include a sealing member or the like (not shown) desirably made of an elastomeric material or the like, which is capable of creating or forming a seal, gasketing effect, or the like with the second member the connector is intended to be used with. It will be appreciated that the sealing member may be located between the first end 208 (Figures 5, 5A and 7) and the second end 210 (Figures 5, 5A and 7) of the body 204 (Figures 5, 5A and 7) of the connector 200 (Figures 5, 5A and 7), but is desirably located closer to the first end 208 of the body 204 than the protrusion 202 (Figures 5, 5A and 7). Exemplary material for the sealing member includes, for example, an elastomeric material or the like and an exemplary embodiment may take the form of an o-ring, gasket, or the like. Such a seal or the like can act to reduce, minimize or prevent leakage from the ferrule when the connector is inserted therein.

In the embodiment shown in Figure 7, when it is desired to disconnect the connector 200 from the ferrule 70, the connector 200 and ferrule 70 should be rotated relative to one another such that the protrusion 202 is aligned with first portion or leg 77a of slot 77 of the ferrule 70. Once the protrusion is aligned with the leg 77a of slot 77, the connector 200 may be withdrawn from the ferrule 70 when sufficient force in the proper direction is applied.

Referring to the illustrative drawing of Figure 10, there is shown an alternative embodiment of a ferrule 126 in accordance with the invention. The alternative ferrule 126 is generally similar to the ferrule 70 (Figures 6 and 7) except that it includes only two interior wall regions 128, 130 instead of the three such regions 82, 84, 86 (Figure 9) of the ferrule 70 (Figures 6 and 7). The ferrule 126 includes a conduit having a central axis 132. The conduit extends between an inlet opening 134 and an outlet opening 136. Thus, the structure and operation of the alternative ferrule 126 will be appreciated from the above description of ferrule 70 (Figures 6 and 7) and need not be set forth again herein. As above, it will be appreciated that a connector having a protrusion located at a point closer to the second end of the connector than in the embodiment shown in

Figures 5, 5A and 7 and/or a second protrusion (as in Figures 8 and 8A) may be desirable and/or necessary for the connector and ferrule 126 to cooperatively engage each other.

Thus, the connectors 200 (Figures 5, 5A and 7) in accordance with the present embodiments of the invention advantageously can be used to ensure that insertion, interconnection and removal from an end portion of a feeding tube or the like is facilitated without the exertion of undue force and without resulting in unwanted stretching of the end portion. Furthermore, the outer surface of connectors in accordance with the present invention can be sized and contoured to precisely conform to the shape of a number of different ferrule portions, however, as indicated above, the creation of a taper lock or the like between the connector and the ferrule while desired is not necessary. Further still, the connectors of the present invention advantageously can reduce or minimize undesired disconnections or separations from a second member. Such disconnections or separations may be avoided even in those instances in which a taper lock or the like is not achieved as was required with previous ferrules and connectors.

While the invention has been described in detail with respect to specific embodiments thereof, those skilled in the art, upon obtaining an understanding of the invention, may readily conceive of alterations to, variations of, and equivalents to the described embodiments and the processes for making them. It is intended that the present invention include such modifications and variations as come within the scope of the appended claims and their equivalents.

We claim: